SECTION IV. SYSTEM THEORY OF OPERATION

1.4.1 INTRODUCTION

This section describes the ASOS at the system level. Detailed information on the various subassemblies is provided in the specific Chapter for that subassembly. Each ASOS is configured to meet the specific requirements of a given site. Configuring a system entails identifying the specific sensors required and the number and types of users that are to have access to the system. Regardless of the type of configuration, the ASOS always contains four major units: acquisition control unit (ACU), data collection package (DCP), sensors, and peripherals. Figure 1.4.1 illustrates a typical ASOS configuration. ASOS configurations differ in the number of each component contained in the configuration. The major differences are in the number of DCP's, sensors, and peripherals at the site. Regardless of the configuration, each site is provided with only one ACU. There are two major types of ASOS systems: Class I and Class II. Class I systems are designed for small airports. Class II systems are designed for larger, towered airports. Class II systems are provided with uninterruptible power supplies (UPS's) and $
UPS bypass circuits for the ACU and DCP(s) and redundant components in the ACU. $

1.4.2 ACQUISITION CONTROL UNIT (ACU)

The ACU is the central controlling element of the ASOS. It receives weather information from the sensors via the DCP. The ACU processes the weather data via weather reporting algorithms and makes these data available to the various users via the peripheral devices attached to the system. In Class II systems, the ACU is equipped with the auxiliary UPS backup power supply. In addition, the Class II ACU contains redundant rf modems or line drivers for increased system availability.

1.4.3 PERIPHERALS

The peripheral devices consist of one to three operator interface devices (OID's), one to four video display units (VDU's), one to nine controller video displays (CVD's), an FAA handset, and a printer. In addition to these ASOS peripherals, the ACU may be equipped with a video driver option that allows it to provide a video signal for distribution to up to 50 non-ASOS airline displays. All other output from the system is via direct connection (hardwire) or modems, which are connected to the ACU via telephone lines. The modem interface also services the AFOS. The OID is the primary operator input/output device for the system. The observer uses the OID to monitor the weather data being reported by the system. Observers also use the OID to enter weather observations into the system and to request weather summaries from the system. The technician uses the OID to check system status, to reconFigure the system, and to run the on-demand diagnostic test on specific elements of the system. The VDU and CVD are display devices that provide weather data to other users of the system such as the air traffic controllers (ATC's). The CVD's serve ATC's in the tower and the VDU's can be located throughout the airport to be used by the various personnel. A digitized voice output is routed to a local transmitter, which provides local weather and pressure data to pilots using the airport. The FAA handset enables ATC's to augment messages onto the automatically generated digitized voice output of weather data. The printer is the hard copy device for the system. It provides a hard copy output of data such as weather summaries, observations, and log messages. The log messages identify the system status and changes $
made to the METAR observation by the observer. The system maintenance log provides the technician $
with the maintenance history of the system and provides the results of each self-test performed on the system. If a unit in the ASOS fails its self-test, the log indicates the cause of the failure.

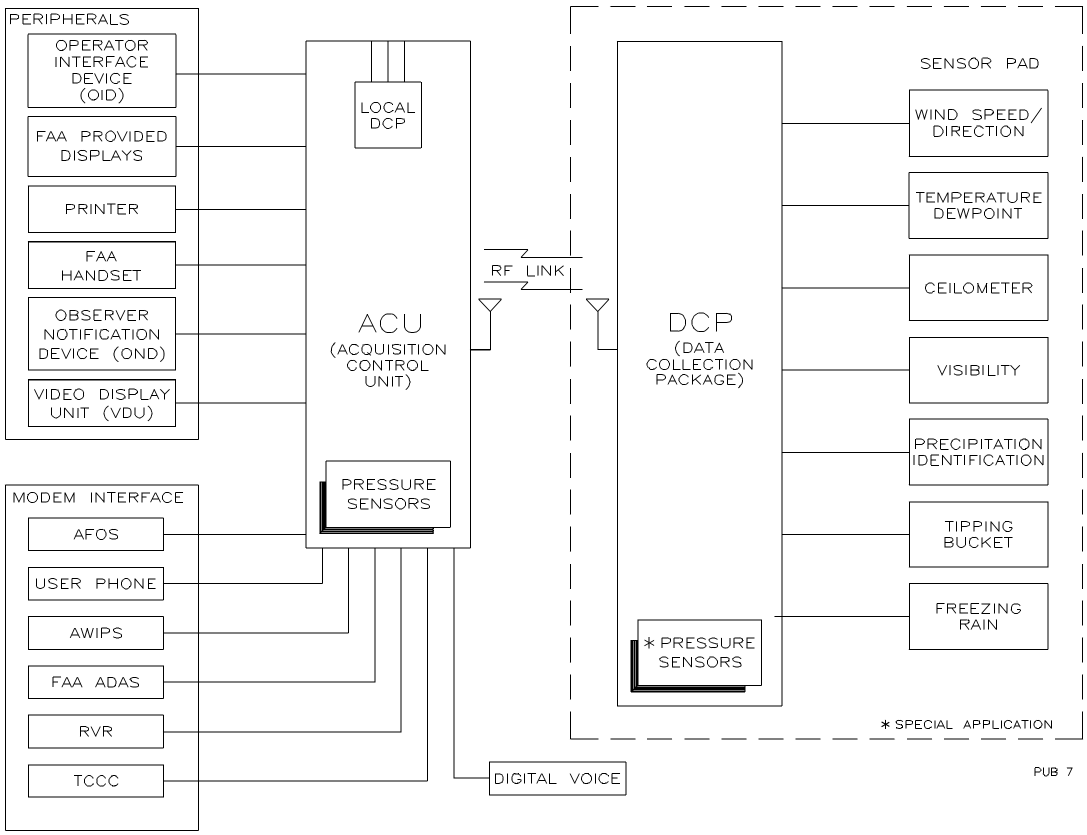

Figure 1.4.1. Typical ASOS Configuration - Basic Block Diagram

1.4.4 DATA COLLECTION PACKAGE (DCP)

The DCP processes the weather data being received from the sensors and transfers the data to the ACU. The DCP also controls both primary and heater sensor power. The system can utilize two types of DCP's: a local and a remote. The remote DCP's are located on the sensor pads. Each remote DCP has the data handling capability to support up to 16 sensors. However, the remote DCP optional UPS can only
$ provide power to nine sensors. Therefore, when using more than nine sensors on a sensor pad, an auxiliary box (62828-40370) is required. The optional auxiliary box, which is considered part of the remote DCP, contains the additional UPS. Many sites are equipped with more than one remote DCP. When more than one remote DCP is used, they are usually placed at different locations at the airport with some installed near the runways and one installed in the center of the airport. The units installed near the runway are called touchdown zone DCP's. The units in the center of the airport are called the "combined zone sensor group". At some sites, redundant ceilometer and visibility sensors are added to the combined group to function as a backup sensor group.

DCP's and sensors installed in areas of meteorological discontinuity are called METDISCON Sensor Groups (MDSG). Communications between the different DCP's are controlled by the ACU. Communications between the ACU and DCP's are accomplished primarily via rf modems. The system also has the capability of a direct wire hookup between the DCP's and the ACU. The local DCP is a function contained within the ACU cabinet. The local DCP gives the ACU the capability of directly
$ controlling sensors. The pressure sensors in all of the systems are normally located in the ACU cabinet
$ (due to site specific requirements, pressure sensors may be located in the DCP). In addition to the pressure sensors, the ACU can also handle up to three additional sensors via the local DCP. These sensors are connected to the rear of the ACU via fiberoptic modems.

1.4.5 **SENSORS**

The sensor complement, like most other system components, reflects the requirements of the individual sites. Some sites may be provided with more than one of the same type of sensor to function as METDISCON or BACKUP sensors. The cloud height and visibility sensors are often duplicated at a site, with a maximum of three each possible; PRIMARY (designated as C1 and V1), METDISCON (designated as C2 and V2), and BACKUP (designated as C3 and V3). Usually, each touchdown zone is provided with its own cloud height and visibility sensor. This ensures that the cloud and visibility conditions at that specific runway are being reported accurately.

Some airport sites will experience meteorological phenomena which are peculiar to one runway approach only. At such locations, a meteorological discontinuity (METDISCON, or MDSG) sensor group will be located, consisting of a DCP and three sensor pedestals. The MDSG is similar to the standard touchdown zone installation (62828-40107), but the sensor complement will consist of a visibility sensor, a ceilometer, or possibly, both. The MDSG DCP communicates with the ACU via UHF modems.

1.4.6 **ASOS OPERATION AND MONITORING CENTER (AOMC)**

1.4.6.1 **ASOS/AOMC Interface**. The ASOS Operation and Monitoring Center (AOMC) is the central monitoring and maintenance computer for all NWS ASOS sites. The AOMC performs three functions for every NWS ASOS: the monitoring of ASOS hardware trouble, the maintenance of site specific data, and ASOS time synchronization.

1.4.6.2 **ASOS Trouble Monitoring.** The AOMC monitors all ASOS METAR's through an NWS computer system known as the gateway. If a particular ASOS outputs a maintenance flag ($) in METAR or if the AOMC fails to receive a METAR during the proper time period, the AOMC notes a hardware problem with that ASOS site. The AOMC operator then uses a remote maintenance monitor to further investigate the problem and then notifies the appropriate maintenance personnel.

1.4.6.3 **ASOS Site Specific Data**. For each NWS ASOS site, the AOMC maintains the latest configuration of site specific data. The site specific data are contained in four site files, six configuration files, a command file, and a voice file as follows: $

a. Site - Normals
b. Site - Physicals
c. Site - Pressure
d. Site - Criterion
e. Configuration - Definitions
f. Configuration - RS-232 communications
g. Configuration - Sensors
h. Configuration - Hardware
i. Configuration - Externals
j. Configuration - Sensor Firmware Version $
k. Command - Voice/password
l. Voice - Airport name

1.4.6.3.1 **File Upload and Download.** Site specific files can be either uploaded from the ASOS to the AOMC or downloaded from the AOMC to the ASOS. Uploading and downloading is always initiated by the ASOS (it places a phone call to the AOMC and requests a download or an upload). The ACU may initiate an upload or download sequence automatically. For example, the ASOS initiates an upload after a technician changes system configuration via the OID, or initiates a download request if it detects a loss of site data. An upload or download may also be initiated manually via the site version - AOMC screen at the OID (paragraph 1.3.17.2).

1.4.6.3.2 **Upload/Download Sequence.** The ACU has between two and five telephone modems dedicated to remote OID's (user ports 1 and 2, user spare ports 1 and 2, and the spare OID port). The ACU uses these telephone modems to place calls to the AOMC. When an upload or download sequence has been initiated (either automatically or manually), each available (not in use) OID modem places a call every 2 minutes until a connection to the AOMC is made. After the connection is made, the ACU either uploads files to the ACU or requests a file download from the AOMC.

1.4.6.4 **ASOS Time Synchronization**. Each ASOS has an internal software clock. All ASOS software clocks are synchronized to a time standard provided by the automated computer time service (ACTS). The time synchronization of the ASOS clocks is accomplished with the aid of the AOMC.

1.4.6.4.1 **AOMC Interface to ACTS.** The AOMC communicates with the ACTS to keep its own internal software clock in synchronization with the time standard. Individual ASOS sites call the AOMC as required to synchronize their internal software clocks.

1.4.6.4.2 **ASOS Synchronization Sequence.** The ASOS time synchronization sequence begins when the ACU is powered up or when an observer presses the RESET key on the edit screen. At first, the ACU uses a hardware real-time clock (contained on the ACU memory board) as a default clock. As soon as possible after the power up or reset, the ACU calls the AOMC to obtain the current standard time. The ACU then initializes its software clock with the AOMC time and stops using its default hardware clock. Ten hours later, the ACU again calls the AOMC to check its software clock against the standard time. Based on the difference between the software clock and AOMC time, the ACU introduces a correction factor into its software clock to adjust its accuracy. One week later, the ACU again calls the AOMC for a time check and further adjusts its software clock. From this point, the ACU calls the AOMC once every 2 months to check and adjust its software clock.